Global Change and Air Pollution

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Future ozone and particulate matter (PM) air quality will depend not only on domestic changes in emissions of ozone and PM precursors, but also on global changes in emissions and perturbations to air pollution meteorology driven by climate change. The EPA/STAR (Science to Achieve Results) Global Change and Air Pollution (GCAP) project investigates these effects of global change on ozone and PM air quality in the United States from 2000–2050. It is a multi-institutional effort involving groups at Harvard, Caltech, University of Tennessee, National Aeronautics and Space Administration (NASA) Goddard Institute of Space Studies (GISS), and Argonne National Lab in collaborations with scientists at EPA/Office of Research and Development (ORD) and EPA/Office of Air Quality Planning and Standards (OAQPS). The trends in long-lived greenhouse gases and anthropogenic emissions of ozone and PM precursors are taken from current Intergovernmental Panel on Climate Change (IPCC) scenarios with updates. We use the NASA/GISS general circulation model (GCM), including a tracer transport capability to explore the response of air pollution meteorology to climate change during 2000–2050; preliminary results show a decrease in cyclone frequency ventilating the northeastern and midwestern United States, resulting in increased duration and severity of summertime pollution episodes. We have coupled a global 3-D model of atmospheric composition (GEOS-Chem), including a fully coupled treatment of tropospheric ozone-NO_x-VOC (volatile organic compounds) chemistry and aerosols, with the GISS meteorological fields describing the present and future climate, and the simulation results for present-day climate were evaluated with observations for ozone and PM both in the United States and globally. We have implemented the trends in global anthropogenic emissions of ozone and PM precursors from 2000–2050 in the GEOS-Chem model and coupled GEOS-Chem with the EPA/Community Multiscale Air Quality (CMAQ) regional air quality model for improved simulation of pollution scales.

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